United States Department of the Interior, Oscar L. Chapman, Secretary
Fish and Wildlife Service, Albert M. Day, Director

- - - - - - - - - - -

Wildlife Leaflet 264

Washington 25, D. C. Revised September 1950

EMETIC AGENT IN TOXIC RAT BAIT, A SAFEGUARD FOR DOGS AND CATS

H. J. Spencer, Branch of Wildlife Research

Red squill is an important raticide because of its general effectiveness combined with emetic properties that serve as a protection against fatal poisoning of domestic animals but do not operate in the same way among rats. Its inadequacy in controlling rats under some conditions, however, necessitates the frequent use of other less specific poisons, the high toxicity of which renders their general employment inadvisable. With increased demand for such potent poisons in rodent control the need for safeguarding their use is of prime importance.

EARLIER STUDIES

The staff of the Wildlife Research Laboratory, Denver, Color., early in 1937 actively engaged in the study of so modifying drastic poison baits that when used in controlling rats they would be harmless to other animals. Various emetics, including copper sulphate, zinc sulphate, and tartar emetic, used in 1 to 5 percent concentrations in hamburger bait, were tested on dogs. Of these, copper sulphate gave indication of being most useful. In preliminary trials rats did not seem to discriminate against a 2 percent concentration of this salt in thallium-poisoned bait.

Later, copper sulphate was used in zinc phosphide baits in the control of field mice (Microtus) in orchards in the New England States. Acceptance was considerably lower than for bait free of the emetic but was improved as the quantity of copper sulphate was decreased. A 4 to 1 ratio, however, did not materially improve acceptance over that of the 3 to 1 mixture. Dogs survived test feeding of mouse bait containing zinc phosphide and copper sulphate mixed in ratios of even 2 to 1, and 1 to 1.

Apparently chemical reaction between copper sulphate and zinc phosphide under certain conditions affected the durability of the compound. Further study disclosed that there was little probability of bringing about effective emesis in dogs. There was little likelihood also that dogs would be accidentally poisoned by picking up one or two of the small baits as properly exposed for the control of field mice. These facts led to decreased interest in the emetic-poison study in orchard mouse control.

RECENT WORK

In 1942 study was resumed to improve methods for the control of rats as part of a wartime project. The principal goal of this work was to afford protection to dogs and cats, the most frequent victims of accidental poisoning from rat bait. The investigations were designed to appraise the emetic properties on dogs and cats of antimony oxide, copper sulphate, zinc sulphate, and tartar emetic (antimony-potassium tartrate) in combination with the poisons zinc phosphide, thallium sulphate, and barium carbonate, and to learn the acceptability to rats of bait in which these chemicals were incorporated.

In these investigations 91 dogs and 41 cats were used. Alexandrine rats (Rattus rattus alexandrinus) were selected for the bait-acceptance trials. Tests involving the use of the poisons were based on the following minimum lethal dose ratings: zinc phosphide, 40 mg./kg. (milligrams per kilogram); thallium sulphate, 35 mg./kg.; and barium carbonate, 700 mg./kg.

Antimony Oxide

Antimony oxide was tested on the basis of reports that it caused emesis in dogs when used in combination with zinc phosphide, but it did not so affect two out of three experimental animals. These dogs were given 75, 75, and 98 mg./kg., respectively, of zinc phosphide and an equal quantity of antimony oxide. The first and third of the animals, in which emesis did not occur, died within 24 hours; the second vomited within 78 minutes and survived. Zinc phosphide alone induced emesis in a dog fed 50 mg./kg. of the poison, and this animal survived. Two dogs given 100 mg./kg. doses of the poison died in about 12 hours without having vomited.

Copper Sulphate

Copper sulphate, although found to be relatively effective in inducing emesis in dogs, was not sufficiently acceptable to Alexandrine rats to warrant its use in bait.

Zinc Sulphate

Zinc sulphate in doses up to 15 mg./kg. did not produce emesis in dogs and cats.

Tartar Emetic (Antimony-Potassium Tartrate)

Tartar emetic in doses as low as 2.5 mg./kg. caused emesis in dogs and cats. Maximum results were obtained from doses of 15 to 25 mg./kg., no material increase in speed of emesis being evident from doses in excess of 25 mg./kg. No positive toxic action from tartar emetic alone was observed in doses as high as 160 mg./kg., although the death of one animal was attributed to gastro-intestinal irritation supposedly brought on by the emetic agent that accompanied a 50 mg./kg. dose of zinc phosphide. The only noticeable reaction of the animals to tartar emetic aside from emesis is a general depressive effect lasting from 12 to 24 hours, during which time they are off feed. No discrimination on the part of Alexandrine rats against tartar emetic was observed.

Twenty-two dogs were used in a wide range of experiments in which 50 to 100 mg./kg. of zinc phosphide (1¼ to 2½ minimum lethal dose) with 25 to 100 mg./kg. of tartar emetic were administered to them in hamburger bait. All the dogs vomited within 57 minutes to 2 hours and 33 minutes, and the average being 1 hour and 31 minutes. Twenty-one survived; one, although undergoing emesis within 1 hour and 14 minutes, succumbed to the poison.

Ten dogs and fifteen cats were fed thallium sulphate in quantities of 35 to 150 mg./kg. (1 to about 4¼ minimum lethal dose) accompanied by 2.5 to 112.5 mg./kg. of tartar emetic, both being mixed in hamburger bait. Twenty-three of the animals vomited within from 45 minutes to more than 6 hours, the average being 1 hour and 50 minutes. The two animals that did not vomit were cats. All 10 dogs survived, but 7 of the 15 cats succumbed.

Ten dogs were given 800 to 1,500 mg./kg. of barium carbonate (1 to 2 minimum lethal dose) with 80 to 150 mg./kg. of tartar emetic in hamburger bait. All the dogs vomited rather promptly, within 37 to 59 minutes, or an average of 45 minutes. Nine of the ten survived; the dog that succumbed was in ill health at the beginning of the experiment.

It is apparent that enough tartar emetic to be effective at a single dose should be used to supplement the full minimum lethal dose of each of the poisons. On this basis a 40 mg./kg. dose of zinc phosphide (assumed as the minimum for that poison) would call for a supplementary dose of 15 mg./kg. of tartar emetic. Likewise, the same quantity of tartar emetic would be used to supplement a 35 mg./kg. dose of thallium sulphate, and a 700 mg./kg. dose of barium carbonate. These combinations are the "dose units" subsequently mentioned.

A study was next undertaken to determine survival in animals ingesting 1 to 5 of the dose units. In one experiment 30 dogs divided into 3 groups of 10 each were used. The first 10 dogs, in five subgroups of 2 each, were fed 1 to 5 dose units, respectively, of zinc phosphide-tartar emetic. The 10 dogs of the second lot (similarly divided into subgroups of 2 each) were given 1 to 5 dose units, respectively, of

thallium sulphate-tartar emetic. Because of the previously observed speed at which emesis occurred in animals fed barium carbonate-tartar emetic, the 10 dogs destined to receive that poison were divided into two subgroups of 5 each. The 5 dogs of one of these subgroups were fed 1 to 5 dose units, respectively, of barium carbonate-tartar emetic of the type originally compounded. The 5 dogs of the other subgroup were given 1 to 5 dose units, respectively, of barium carbonate supplemented with one-third less of tartar emetic than was given to the dogs of the first subgroup.

The 10 dogs receiving the 1 to 5 dose units of zinc phosphide-tartar emetic vomited within an average time of 1½ hours, and all survived.

The 10 dogs fed the 1 to 5 units of thallium sulphate-tartar emetic experienced emesis within an average of 2 hours. The 6 dogs of the first three subgroups that were given 1 to 3 dose units survived, but only one in each of the subgroups that received 4 and 5 dose units survived.

The 5 dogs given the 1 to 5 dose units of barium carbonate, with a full quota of tartar emetic, vomited within an average of 45 minutes, and all survived. The five fed 1 to 5 dose units of barium carbonate, with a reduced quantity of tartar emetic, reached emesis in an average of 1-3/4 hours, and all survived.

By increasing the ratio of the thallium sulphate-tartar emetic combination from 7-3 to 7-4, speedier emesis was obtained. This resulted in survival of animals in the thallium series to approximately the same proportion as in those of the zinc phosphide and barium carbonate series.

The irregularity and wide range of time in which emesis was produced in dogs and cats from identical doses of tartar emetic led to a study of the possible physiological factors involved. The degree of hunger in animals was strongly indicated as a contributing factor; consequently an experiment was performed in which the hunger factor so far as could be arranged was the only variable. Six cats in three groups of 2 each were conditioned as follows: The cats of the first group were deprived of food for 48 hours; those of the second were held without food for 15 hours; and those of the third were given a generous meal 4 hours prior to the administration of the poison.

Each of the 6 cats was then given 4 units of zinc phosphide-tartar emetic in hamburger bait. The two cats in the first group, considered to be in a starved condition, reached emesis in an average of 1 hour and 2 minutes; those of the second group, with empty stomachs, in an average of 1 hour and 15 minutes; and those of the third group, having full stomachs, in an average of 2 hours and 10 minutes. Although the rapidity at which emesis was induced in the experimental animals, on a group average basis, was in direct ratio to the degree of hunger, individually, the speed of emesis was inconsistent with the hunger factor. Evidence indicates that emesis brought about by tartar emetic is subject to the tolerance of the individual animal.

The temperament, or psychological reaction, of the animal also was found to be a factor contributing to the results. Four poor-game cats that had become wild were used during a temporary shortage of desirable, normally healthy animals. These cats were employed in tests similar to those in which

thoroughly tame ones were used. Although emesis was induced in the wild cats as effectively as in the tame ones, for some unexplained reason the wild cats refused food after the second day after feeding was resumed following emesis. These cats refused to take food of any kind from that time until their death; nor were they observed to drink water or milk during that period. The psychological reaction of the cats to the physiological upset combined with forced confinement is believed to be the principal cause of their death. Malnutrition and the action of the rodenticide directly or indirectly, also were contributing factors. Similar experiments with tame cats resulted in 100-percent survival.

Animals affected by ill health or serious malnutrition do not respond favorably to the protective action of tartar emetic. Without exception, dogs and cats so afflicted died as a result of ingesting the emetic-bearing rodenticide. The emetic was not effective in some of these animals, while in others it either acted within a normally expected or seriously prolonged time. Regardless of the time emesis took place, however, the animal eventually died, apparently from the action of the toxic agent.

The reaction of dogs to the vomited material became a factor in the studies. It was not uncommon for dogs to reingest their own vomit. A number of them were observed to go through this performance a second, and even a third, time. Despite this repeated ingestion most of them survived.

Laboratory and field studies of the acceptance by Alexandrine, black, and Norway rats of toxic bait with and without tartar emetic did not disclose any distinction between the two types of baits on the part of the rats. There is no evidence that the addition of tartar emetic is in any way detrimental to the acceptance of the bait by rats.

SUMMARY

In summarizing the experiments it is worthy of note that tartar emetic added to bait was instrumental in bringing about the survival of 107, or 81 percent, of 132 dogs and cats fed 1 to 5 minimum lethal doses of zinc phosphide, thallium sulphate, and barium carbonate. So far as could be determined, survival and recovery were complete. No loss of hair occurred in animals to which thallium was administered.

These facts lead to the following conclusions: The primary toxic action of 1 to 5 lethal doses of zinc phosphide, thallium sulphate, and barium carbonate can be appreciably reduced or nullified in dogs and cats by tartar emetic used to supplement these poisons in baits for the control of injurious rodents. These poisons may be incorporated with tartar emetic in the following proportions:

Zinc phosphide, 8 parts; tartar emetic, 3 parts;
Thallium sulphate, 7 parts; tartar emetic, 4 parts;
Barium carbonate, 140 parts; tartar emetic, 3 parts.
ANTU, ..., 2 parts; tartar emetic, 1 part

There should be no deduction from these experiments, direct or implied, that similar benefits would accrue to human beings ingesting such materials.

as effectively as in the tame ones. For some unexplained reason the wild rats refused food after the second day after feeding was resumed following emesis. These rats refused to take food of any kind from that time until their death; nor were they observed to drink water or milk during that period. The psychological reaction of the rats to the physiological upset combined with forced confinement is believed to be the principal cause of their death. Malnutrition and the action of the rodenticide directly or indirectly also were contributing factors. Similar experiments with tame rats resulted in 100-percent survival.

Animals affected by ill health or serious malnutrition do not respond favorably to the protective action of tartar emetic. Without exception, dogs and cats so afflicted died as a result of ingesting the arsenic-bearing rodenticides. The emetic was not effective in some of these animals, while in others it [illegible] acted within a period of [illegible] a seriously prolonged time. Regardless of the time emesis took place, however, the animal eventually died, apparently from the action of the toxic agents.

The reaction of dogs to the vomited material became a factor in the studies. It was not uncommon for dogs to reingest their own vomit. A number of them were observed to go through this performance a second, and even a third, time. Despite this repeated ingestion most of them survived.

Laboratory and field studies of the acceptance by Alexandrine, black, and Norway rats of toxic bait with and without tartar emetic did not disclose any distinction between the two types of baits on the part of the rats. There is no evidence that the addition of tartar emetic is in any way detrimental to the acceptance of the bait by rats.

SUMMARY

In summarizing the experiments it is worthy of note that tartar emetic added to bait was instrumental in bringing about the survival of 107, or 81 percent, of 132 dogs and cats fed 1 to 5 minimum lethal doses of zinc phosphide, thallium sulphate, and barium carbonate. So far as could be determined, survival and recovery were complete. No loss of hair occurred in animals to which thallium was administered.

These facts lead to the following conclusions: The primary toxic action of 1 to 5 lethal doses of zinc phosphide, thallium sulphate, and barium carbonate can be appreciably reduced or nullified in dogs and cats by tartar emetic used to supplement these poisons in baits for the control of injurious rodents. These poisons may be incorporated with tartar emetic in the following proportions:

Zinc phosphide, 8 parts; tartar emetic, 4 parts;
Thallium sulphate, 7 parts; tartar emetic, 4 parts;
Barium carbonate, 140 parts; tartar emetic, 8 parts.
ANTU, ..., 2 parts; tartar emetic, 1 part

There should be no deduction from these experiments, direct or implied, that similar benefits would accrue to human beings ingesting such materials.

Interior Duplicating Section--Wash., D. C.